TITLE

CONSTANT JOINING MATERIAL IN VORTEX-TYPE AIR-SPINNING METHODS

FIELD OF INVENTION

[0001] The present invention relates to a method for operating a drafting arrangement, to a control for drafting arrangements of a textile machine, and to a textile machine having a said control.

BACKGROUND OF INVENTION

[0002] Methods for operating drafting arrangements are known in textile technology. The publications EP 121 97 37, EP 807 700 and EP 137 57 09 describe methods of this type. However, as is evident from the publications mentioned, the present invention is suitable particularly for the operation of drafting arrangements which belong to air-spinning machines. In air-spinning machines, a fiber composite is spun into a yarn by means of one of more airflows.

[0003] The known methods for operating a drafting arrangement, however, have disadvantages. This applies particularly to drafting arrangements which belong to air-spinning machines or to drafting arrangements which transfer the drafted fiber composite to a spinning unit operating according to an air-spinning method. The disadvantage of the known methods for operating a drafting arrangement is that the piecer quality is not always satisfactory. The term "piecer" is understood to mean a "seam", within a yarn, at which the yarn has been "pieced up" or "hung up" again, for example after an interruption in production. Preferably, a piecer or piercing point should not differ from the remaining yarn, particularly with respect to strength and fiber mass. In an endeavor to achieve this ideal state, various possibilities are disclosed in the abovementioned publications. For example, the fiber end at which piecing is to take place may be narrowed and/or the drafting arrangement delivers fewer fibers in the overlap region than in the subsequent stationary operating state. Irrespective of this, however, in the known devices, there is a further problem which the present invention now intends to solve.

[0004] When a drafting arrangement is put into operation and therefore when the associated pairs of rollers are put into operation or accelerated, a build-up of the rotational speed profile to the corresponding piecing speed takes place. This build-up, which is caused by the run-up of the pairs of rollers from standstill to their corresponding piecing speed or piecing rotational speed , gives rise, when the piecing rotational speed is first reached, to a non-constant rotational speed ratio between the pairs of rollers of a drafting arrangement resulting in overshooting and undershooting. Normally, in a drafting arrangement, the piecing operation commences during the acceleration of the pairs of rollers to an operating speed or immediately after a fixed piecing speed is reached. In other words, the build-up of the pairs of rollers during their acceleration to the piecing speed has never been taken into account hitherto in the production of a piecer. This has hitherto given rise to a piecer obtained at non-constant rotational speeds or a non-constant rotational speed ratio between the two pairs of rollers of a drafting arrangement . To be precise, due to the overshooting and undershooting of the pairs of rollers, an inaccurate or varying draft occurs in the fiber composite. When this varyingly drafted fiber composite is combined with a yarn end, thus giving rise to a piecer, the piecer has mass fluctuations . Thus, in the overlap region of the piecer, there may be an unacceptable thickening followed by an unacceptable thinning of the yarn. Conversely, a thin place occurs in the overlap region or piecing fails completely.

SUMMARY OF THE INVENTION

[0005] A summary of exemplary embodiments of the present invention will be set forth here. Using the description provided herein, one skilled in the art will understand that additional exemplary embodiments are within the scope of the present invention.

[0006] The object of this invention is to provide a method for operating a drafting arrangement for the drafting of a fiber composite where mass fluctuations are avoided or minimized. A further object of this invention is to provide a method for operating a drafting arrangement in which a fiber composite is to be drafted from the outset with the correct draft ratio.

[0007] In one exemplary embodiment, the present invention provides a method for operating a drafting arrangement to prevent mass fluctuations in a fiber composite. The method includes but is not limited to using a front pair of rollers in association with a rear pair of rollers which have a nip line. During the operational process, the front and rear rollers rotate at different speeds or circumferential speeds. When production ceases, the front and rear rollers of the drafting arrangement are stopped in sequence. The front rollers stop before the rear rollers so that the fiber composite is broken at the nip line. To avoid mass fluctuations when the drafting arrangement commences operation, the rear pair of rollers rotate before the front pair of rollers rotate. The foremost tip of the fiber composite is supplied to the nip line of the rear pair of rollers when the front and rear rollers have ended their acceleration build-ups.

[0008] In a further alternative embodiment, both the front and rear rollers commence rotation simultaneously. In this embodiment, the fiber composite end is brought a specific distance from the nip line of the rear pair of rollers so that when the fiber composite end reaches the nip line, both pairs of rollers have ended the build-up arising from acceleration.

[0009] In an alternative embodiment, the process may use a further pair of rollers in association with the front and rear rollers. Drafting may also take place between the further pair of rollers and the front pair of rollers.

[0010] In a further alternative embodiment, the fiber composite exits the rear rollers and is delivered to a spinning unit for further processing. The spinning unit then spins the fiber composite into yarn.

[0011] In a further alternative embodiment, the spinning unit is a vortex type air-spinning unit that contains a vortex chamber and a spindle. An air-vortex flow is generated in the vortex chamber and causes the fiber composite to spin and form yarn.

[0012] In a further alternative embodiment, the spindle is a non-rotating spinneret.

[0013] In a further alternative embodiment, the fiber composite is pieced with yarn. An existing yarn end is drawn through the nip line of the rear pair of rollers and cut to a specific

length and positioned appropriately for operation. The rear pair of rollers rotate followed by the front pair of rollers. The length of the yarn is determined such that when the fiber composite reaches the nip line, both the front and rear rollers have ended the build-up arising from acceleration. When piecing occurs, parts of the yarn end and the front region of the fiber composite overlap. This overlap region is spun in the spinning unit to form a piecer. Piecing preferably takes place at a constant rotational speed. After piecing occurs, the front and rear rollers attain their respective operational rotational speeds.

[0014] In a further alternative embodiment, the yarn end is drawn through a spinning unit and through the nip line of the rear pair of rollers.

[0015] In a further alternative embodiment, piecing takes place virtually at the operating rotational speed.

[0016] In a further alternative embodiment, a control operates the drafting arrangement. In this embodiment, the roller pairs have specific drives which the control controls.

[0017] In a further alternative embodiment, the control and drive for the front rollers move the fiber composite end back from the nip line.

[0018] The present invention is not restricted to the embodiments described herein. Rather, the variations of the exemplary embodiments discussed above are intended to be incentives for the person of ordinary skill in the art to implement the idea of the invention in as favorable a manner as possible. Accordingly, further advantageous embodiments and combinations can be easily derived from the embodiments described as shown herein. The applicants therefore expressly reserve the right to make provision for such further advantageous embodiments and combinations.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] A full and enabling disclosure of the present invention, including the best mode thereof, directed to one of ordinary skill in the art, is set forth in the specification, which makes reference to the appended figures, in which:

Figure 1 shows a drafting arrangement according to an exemplary embodiment of the invention;

Figure 2 shows the rotational speed profiles of the front and rear pair of rollers;

Figure 3 shows a drafting arrangement according to an exemplary embodiment of the present invention prior to piecing action;

Figure 4 shows a drafting arrangement and following spinning unit in a stationary operating state according to an exemplary embodiment of the present invention; and

Figure 5 shows a control which operates the drafting arrangement according to an exemplary embodiment of the invention.

DEFINITIONS

[0020] Within the context of this specification, each term or phrase below will include the following meaning or meanings.

"$U_4(t)$"	Rotational speed profile of the rear pair of rollers 4
"$U_3(t)$"	Rotational speed profile of front pair of rollers 3
"$U_{A,4}$"	Piecing rotational speed for the rear pair of rollers 4
"$U_{A,3}$"	Piecing rotational speed for the front pair of rollers 3
"$t_{s,3}$"	Time point for operating the front pair of rollers 3
"$t_{h,3}$"	Period of time until the front pair of rollers 3 reaches the piecing rotational speed $U_{A,3}$ (acceleration)
"$t_{h,4}$"	Period of time until the rear pair of rollers 4 reaches the piecing rotational speed UA,4 (acceleration)
"$t_{EV,3}$"	Period of time until the front pair of rollers 3 has ended the build-up arising from acceleration
"$t_{EV,4}$"	Period of time until the rear pair of rollers 4 has ended the build-up arising from acceleration
"t_k"	Time point commencement of piecing action
"t_E"	Time point end of piecing action
"t_{AE}"	Period of time piecing action
"t_{EVE}"	Time point in which both pairs of rollers have ended the build-up
"$U_{B,4}$"	Operating rotational speed of the rear pair of rollers 4
"$U_{B,3}$"	Operating rotational speed of the front pair of rollers 3

[0021] These terms may be defined with additional language in the remaining portions of the specification.

DETAILED DESCRIPTION OF THE DRAWINGS

[0022] Objects and advantages of the invention will be set forth in the following description, or may be apparent from the description, or may be learned through practice of the invention. Attention should expressly be drawn to the fact, however, that the invention and the idea of the invention are not restricted to the embodiments shown in the examples.

[0023] Figure 1 shows a typical drafting arrangement 1 according to an exemplary embodiment of the present invention. The drafting arrangement 1 has a front pair of rollers 3 and a rear pair of rollers 4 having a nip line 5. The drafting arrangement 1 may have a further pair of rollers 7. The drafting arrangement 1 serves for drafting the fiber composite 2. For this purpose, the pairs of rollers 3 and 4 rotate at different speeds or circumferential speeds. The front pair of rollers 3 and the rear pair of rollers 4 consequently form what is known as the main drafting zone 8 of the drafting arrangement 1. Drafting may also take place between the pairs of rollers 7 and 3 (what is known as predraft). As a rule, a drafting arrangement, such as is illustrated in Figure 1, has at the front pair of rollers 3 and aprons 20 which serve for guiding the fiber composite 2 to be drafted. However, the presence of the aprons 20 is not essential to the invention or is not absolutely necessary. During stationary operation, the fiber composite 2 runs through the pair of rollers 7 (if present) and, above all, through the pairs of rollers 3 and 4. In this case, the fiber composite 2 is drafted and leaves the drafting arrangement 1 at or downstream of the nip line 5 of the rear pair of rollers 4. The drafted fiber composite is thereafter mostly further-processed in the same way (for example, at a spinning unit, see, in this respect, the following Figure 4). If, then, for any reason, an interruption in production takes place or the drafting arrangement 1 generally has to be put into operation again, the fiber composite 2 has to be introduced into the drafting arrangement 1 again or at least correctly positioned. The position of the fiber composite end 6 therefore assumes a particularly important role. The distance from the fiber composite end 6 to the nip line 5 should preferably be up to 6 millimeters, more preferably from 0.1 millimeters to 5 millimeters and most preferably from 3 millimeters to 4 millimeters. These distances are

preferably obtained by cutting the fiber composite end 6 to length. It is unimportant for the invention whether the drafting arrangement 1 in this case has the additional pair of rollers 7 or even also a further pair of rollers. It is normally such that, in the event of an interruption in production, the pairs of rollers of the drafting arrangement 1 are stopped in a sequence whereby the fiber composite 2 is broken away at the nip line 5. For this purpose, the front pair of rollers 3 is stopped before the rear pair of rollers 4. As a result, the fiber composite end 6 is located directly in front of the nip line 5. See, in this respect, for example, the abovementioned EP 137 57 09.

1) When the drafting arrangement 1 is then put into operation again, first, as a rule, the rear pair of rollers 4 commences to rotate before the front pair of rollers 3 itself resumes operation. It may well be that the period of time between the operation of the rear pair of rollers 4 and that of the front pair of rollers 3 is sufficient to ensure that, in the rotational speed profile of the pair of rollers 4, the build-up arising from acceleration is terminated before the front pair of rollers 3 is set in motion. However, since the fiber composite end 6 is located directly in front of the nip line 5 of the rear pair of rollers 4, a drafting of the fiber composite 2 takes place immediately after the front pair of rollers 3 has been put into operation. Since, after being put into operation, the front pair of rollers 3 still has to accelerate to the piecing speed or operating speed, a build-up to the desired piecing rotational speed also takes place here. As a result, that region of the fiber composite 2 which directly follows the fiber composite end 6 is drafted in a fluctuating manner and consequently has undesirable mass fluctuations. If this "initial region" of the fiber composite 2 is used to produce a piecer, then, of course, this piecer, too, has undesirable mass fluctuations.

[0024] That these mass fluctuations occur can also be seen very clearly from Figure 2. The figures shows, *inter alia*, the rotational speed profile $U_4(t)$ of the rear pair of rollers 4 and the rotational speed profile $U_3(t)$ of the front pair of rollers 3. At a time point t + 0, the rear pair of rollers 4 is put into operation. For this purpose, the said pair of rollers 4 is accelerated for a period of time $t_{h,4}$ until the pair of rollers 4 has reached the piecing rotational speed $U_{A,4}$ (for example, ~5 mm/msec). The acceleration of the rollers is very high since the yarn end 10 selected must otherwise be unacceptably long. The run-up therefore takes place during a few milliseconds. Since it is not possible, for physical reasons, for the pairs of rollers to break off

acceleration abruptly in the case of the constant, but very high accelerations when the desired rotational speed is reached, a build-up occurs during a specific period of time $t_{EV,4}$. The same also applies correspondingly to the front pair of rollers 3 (build-up during the period of time $t_{EV,3}$). How long this build-up lasts and how great the overshoots or undershoots are depends on the physical properties of the driven pairs of rollers and on their drive, closed-loop control and open-loop control. By suitable closed-loop controls and drives being used, the period of time t_{EV} can be reduced to a minimum. However, because of the high acceleration of the pairs of rollers, it cannot be prevented completely.

[0025] So that no mass fluctuations occur when a drafting arrangement is put into operation, the foremost tip of the fiber composite) is supplied to the nip line of the second pair of rollers only when both pairs of rollers have ended their corresponding build-ups arising from acceleration. This time point is designated by t_{EVE} in Figure 2: at this time point, both pairs of rollers have reached a constant piecing rotational speed (as illustrated in Figure 2) or they have at least ended the build-up. Then, the drafting of the fiber composite is recommenced no earlier than time point t_{EVE} or, in other words, the fiber composite end should enter the nip line of the rear second pair of rollers and consequently be drafted no earlier than time point t_{EVE}. Preferably, when the fiber composite end 6 enters the nip line 5 of the rear pair of rollers 4, the rollers 16 of the rear pair of rollers 4 have a circumferential speed of at least 300 meters per minute. Alternatively, the fiber composite 11 has a speed of 300 meters per minute immediately after leaving the nip line 5 of the rear pair of rollers 4. If the operation of the drafting arrangement also involves piecing up to a yarn end in addition to this coordinated draft, then the time point for the commencement of the piecing action t_K should not be before the time point t_{EVE}. The time point t_{EVE} is therefore the earliest time point for commencing the piecing action. When a piecing action is carried out, this lasts for a few milliseconds (see the period of time t_{AE}, for example approximately ~ 8 msec) and is concluded at a time point t_E. With the conclusion of the piecing action at the time point t_E, the drafting arrangement can be operated in a stationary mode again. The piecing action preferably takes place at a constant piecing rotational speed $U_{A,4}$ or $U_{A,3}$ and, after piecing has taken place, both pairs of rollers can run up synchronously and more slowly, that is to say without overshoots, to their respective operating rotational speed $U_{B,3}$ and $U_{B,4}$. In an alternative embodiment, piecing takes place virtually at the operating rotational speed, so that the piecing rotational speeds U_{A3} and $U_{A,4}$ already represent the operating speeds for the stationary operation of the

drafting arrangement. The synchronous run-up of the rollers to an operating rotational speed different from the piecing rotational speed is illustrated by dashes in Figure 2.

[0026]Figure 3 shows a drafting arrangement at which a piecing action is to be carried out according to an exemplary embodiment of the present invention. To carry out the piecing action, first, an existing yarn end 10 is drawn, opposite to the actual spinning direction, through the spinning unit 12 which is arranged downstream of the drafting arrangement. The yarn end 10 is likewise guided through the nip line 5 of the rear pair of rollers 4 and, cut to a specific length, is positioned appropriately for operation. When the drafting arrangement is put into operation, first, the rear pair of rollers 4 commences to rotate, as illustrated in Figure 2. Only thereafter is the front pair of rollers 3 put into operation. In an alternative embodiment of the invention, both pairs of rollers are put into operation simultaneously. Before the drafting arrangement is put into operation, however, the fiber composite end 6 is brought, as illustrated, to a specific distance from the nip line 5 of the rear pair of rollers 4. This distance is at least such that, when the fiber composite end 6 reaches the nip line 5, both pairs of rollers 3 and 4 have, in the rotational speed profile, ended the build-up arising from acceleration. When piecing takes place, as described further above, parts of the yarn end 10 and of the front region of the fiber composite 2 illustrated overlap one another. This overlap region is spun in the following spinning unit 12 to form the actual piecer.

[0027] Figure 4 shows a drafting arrangement and its following spinning unit 12 according to an exemplary embodiment of the invention. The figure shows the drafting arrangement 1 and the spinning unit 12 in a stationary operating state. The individual elements correspond to the preceding figures and are given correspondingly identical reference symbols. The rollers 16 of the rear pair of rollers 4 deliver the drafted fiber composite 11 to the spinning unit 12. The spinning unit 12 can spin the drafted fiber composite 11 according to various spinning methods. This figure illustrates a spinning unit 12 which operates according to an air-spinning method (a vortex-type air-spinning method, as it is known). For this purpose, the spinning unit 12 has a vortex chamber 14 that contains a spindle 15. The spindle 15 is, to be precise, a preferably non-rotating spinneret. An air-vortex flow is generated in the vortex chamber 14 by means of nozzles and causes a spinning of the fibers of the drafted fiber composite 11 at the mouth of the spindle 15. Preferably the drafting arrangement 1 and spinning unit 12 are elements of a spinning station of a textile machine. The yarn 13 thereby

produced is taken up correspondingly and wound (not shown) onto a winding device. As may be gathered from the figure, the drafting arrangement 1 also has the pair of rollers 7 which forms with the pair of rollers 3 a predrafting zone 9. It should also again be pointed out explicitly that the method according to the invention for operating a drafting arrangement is not restricted to a specific spinning method, such as the air-spinning method shown here, or to the pressure of the further pair of rollers 7.

[0028] Figure 5 shows a control 19 which operates the drafting arrangement 1. For this purpose, the rear pair of rollers 4 have a specific drive 18 and the front pair of rollers 3 likewise have the drive 17. If, as illustrated here, the drafting arrangement 1 also consists of a further pair of rollers 7 which forms with the pair of rollers 3 a predrafting zone, then the pair of rollers 7 can also be driven by the drive 17 of the pair of rollers 3 (or may have an additional specific drive). In an exemplary embodiment of the invention, the control 19 controls the drives 17 and 18 when the drafting arrangement is put into operation. The control 19 may be connected to correspondingly further monitoring and control devices of a textile machine (the textile machine as a whole not being illustrated).

[0029] Depending on how the drafting arrangement has previously been stopped, the method according to the invention may also include moving the fiber composite end 6 back from the nip line 5 of the rear pair of rollers 4 before the drafting arrangement is put into operation. This may also take place automatically, for example by means of the control 19 and the drive 17. This applies particularly when the fiber composite end 6 is not separated from the nip line 5 of the rear pair of rollers 4 at a predetermined distance by hand. This is desirable, above all, in fully automatic piecing methods and devices, in which the drafting arrangement is first stopped so that the fiber composite 2 breaks away at the nip line 5 of the rear pair of rollers 4. To be precise, in this case, a clearly defined fiber composite end 6 is obtained, which merely has to be positioned appropriately before the drafting arrangement can be put into operation again.

[0030] While the present subject matter has been described in detail with respect to the specific exemplary embodiments and methods thereof, it will be appreciated that those skilled in the art, upon attaining an understanding of the foregoing may readily produce alterations to, variations of, and equivalents to such embodiments. Accordingly, the scope of the present

disclosure is by way of example rather than by way of limitation, and the subject disclosure does not preclude inclusion of such modifications, variations and /or additions to the present subject matter as would be readily apparent to one of ordinary skill in the art.